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Meeting on Turtle By-Catch in Canadian Atlantic Fisheries Hayes Boardroom, BIO 20 March 2001

R. O'Boyle
Science Branch
Bedford Institute of Oceanography
Dartmouth, Nova Scotia
B2Y 4A2

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Foreword

The purpose of this proceedings is to archive the activities and discussions of the meeting, including research recommendations, uncertainties, and to provide a place to formally archive official minority opinions. As such, interpretations and opinions presented in this report may be factually incorrect or mis-leading, but are included to record as faithfully as possible what transpired at the meeting. No statements are to be taken as reflecting the consensus of the meeting unless they are clearly identified as such. Moreover, additional information and further review may result in a change of decision where tentative agreement had been reached

Avant-propos

Le présent compte rendu fait état des activités et des discussions qui ont eu lieu à la réunion, notamment en ce qui concerne les recommandations de recherche et les incertitudes; il sert aussi à consigner en bonne et due forme les opinions minoritaires officielles. Les interprétations et opinions qui y sont présentées peuvent être incorrectes sur le plan des faits ou trompeuses, mais elles sont intégrées au document pour que celui-ci reflète le plus fidèlement possible ce qui s'est dit à la réunion. Aucune déclaration ne doit être considérée comme une expression du consensus des participants, sauf s'il est clairement indiqué qu'elle l'est effectivement. En outre, des renseignements supplémentaires et un plus ample examen peuvent avoir pour effet de modifier une décision qui avait fait l'objet d'un accord préliminaire

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ABSTRACT

In November 2000, the Atlantic Science Director's Committee discussed the interaction between marine turtles and fisheries off the East Coast of Canada and, at its request, a zonal meeting was held at BIO on March 2001 to discuss what is known about turtles and what is the potential for interaction with fishing fleets operating in these waters. A number of experts from DFO, universities, museums, industry and NGOs participated. After a review of the available information, a series of questions were asked, key among these being 'will it be possible to make statements and management recommendations about the overall impact of the fisheries in the Canadian Atlantic zone on turtles', the answer to which was not until the appropriate information had been collected, which may take two – three years. One of the main products of the meeting is a set of recommendations to improve the state of our knowledge on turtle biology and interaction with fisheries.

RÉSUMÉ

En novembre 2000, le Comité des directeurs des sciences de l'Atlantique a discuté de l'interaction entre les tortues marines et les diverses pêches pratiquées au large de la côte est du Canada; à sa demande, une réunion à l'échelle de la zone a eu lieu à l'IOB les 20 et 21 mars 2001, dans le but de discuter des connaissances dont on dispose au sujet des tortues et des interactions possibles de ces dernièrs avec les flottes de pêche qui évoluent dans les eaux considérées. Divers experts du MPO, des universités, de l'industrie et d'ONG prenaient part à cette réunion. Après avoir examiné les renseignements existants, les participants ont posé une série de questions; s'agissant de savoir, en particulier, s'il était possible de formuler des énoncés et des recommandations de gestion sur les répercussions globales que les pêches ayant lieu dans la zone canadienne de l'Atlantique ont sur les tortues, il a été établi que cela ne pourrait se faire sans une information pertinente, dont la collecte pourrait prendre de deux à trois ans. Parmi les principaux résultats de la réunion, signalons une série de recommandations visant à améliorer l'état de nos connaissances sur la biologie des tortues et leus interactions avec les pêches.

INTRODUCTION

The chair (R. O'Boyle) welcomed the participants (appendix 1) and requested introductions from around the table. He then gave a brief background to the meeting. In November 2000, the Atlantic Science Director's Committee (ASDC) of the Canadian Department of Fisheries and Oceans (DFO) discussed the interaction between marine turtles and fisheries in the waters off the east coast of Canada. It requested that a zonal meeting (involving participants from Maritimes, Gulf, Newfoundland, and Laurentian regions) be conducted to investigate the extent of knowledge on this issue. It was recognized that most of the expertise on turtles lies outside DFO and thus a number of participants were invited from universities, museums, NGOs and from the US (National Marine Fisheries Service's (NMFS) Office of Protected Resources and the NMFS Northeast Fisheries Science Center). Also, industry participation was limited to those most directly involved with data collection and provision.

The terms of reference (appendix 2) and agenda (appendix 3) were reviewed and the meeting started. After a primer on turtle biology, an overview of the distribution of the fisheries off Canada's East Coast was provided. This was followed by presentations on the various fleet sectors (trawling, traps, gillnets, etc, and large pelagics. A global view of turtle by-catch was then presented, followed by what information was available on turtle survival after release from fishing gear. The last part of the meeting (completed late on 20 March rather than continued on 21 March) focused on answering the questions raised in the terms of reference and listing recommendations for further work. Specific note of the question 'will it be possible to make statements and management recommendations about the overall impact of the fisheries in the Canadian Atlantic zone on turtles' was made. One of the main products of the meeting was a set of recommendations to ASDC to improve the state of our knowledge on turtle biology and interaction with fisheries. It had been pointed out at the beginning of the meeting that it was not to be a review of the extent of the interaction but rather a synopsis of what data exists that could eventually be used to describe the interaction. Thus, the meeting did not provide management advice.

Some of the participants had prepared documents for the meeting (appendix 4), although due to their preliminary nature, these would not be produced as research documents but would be catalogued as working papers by the Maritimes Region Regional Advisory Process (RAP) Office. The meeting minutes, produced in the CSAS Proceedings series, will be provided to the ASDC, which will consider the recommendations and further action.

PRIMER ON TURTLE BIOLOGY (M. JAMES)

Presentation Highlights

Leatherback turtles are currently listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The initial status report was prepared by Cook (1981), and reflected the limited amount of information available at the time regarding the occurrence of the leatherback in Canadian waters. It was originally listed as endangered by the International Union for the Conservation of Nature (IUCN) in 1969. However, the designation was changed to critically endangered in 2000. Elsewhere, the Pacific population faces

extinction (Spotila *et al.*, 2000), and the number of reproductive females is thought to number less than 34,500 (Spotila *et al.*, 1996).

Loggerheads and leatherbacks both occur off the Atlantic coast, with the loggerhead (*Caretta caretta*) being the most common species, typically being found in greater numbers offshore. There are only a handful of confirmed reports of Kemp's Ridley (*Lepidochelys kempi*) and no confirmed reports of green turtles (*Chelonia mydas*) in Canadian waters. Marine turtles are most often encountered in Eastern Canadian waters in the summer and fall. Juveniles are observed offshore, although they are observed inshore as well. There are only a handful of coastal records. The Loggerheads' distribution is relatively constrained by temperature. They are not generally observed in waters below 15 C.

Considered the most pelagic of all sea turtles, the leatherback (*Dermochelys coriacea*), occurs in shelf waters and further offshore. In Canada, leatherbacks have been recorded as far north as Nain, Labrador (Threlfall, 1978). There are comparatively few reports from the Gulf of St. Lawrence. One tagged animal entered the Gulf in 2000. Large leatherback subadults and adults recruit to the area to eat jellyfish, which is their main food item. They occur off Atlantic Canada primarily during July – Sept as part of a seasonal migration. A telemetry study shows movement of turtles from Canadian waters to the Antilles and to waters off South America. It should be noted that these observations are based on work with Canadian inshore fishermen, which biases the results towards the distribution of this fleet sector.

While growth rates and age at first reproduction are not known, it has been suggested that leatherbacks may mature much faster than other species of marine turtle, potentially reaching adult size in 5-14 years (Zug & Parham, 1996). The majority of nesting in the Atlantic occurs in French Guiana, Suriname, Trinidad and Gabon, West Africa. However, leatherbacks nest in small numbers at several other locales including Brazil, many islands in the Caribbean, Costa Rica, Panama, Columbia, and Florida. The only evidence for source populations for leatherbacks encountered in Canadian waters comes from a female turtle captured off Newfoundland in 1987 that was flipper-tagged earlier that year in French Guiana (Goff *et al.*, 1994). A current Dalhousie telemetry study has revealed movements to waters adjacent to known nesting beaches. Clutch size (approx. 80 eggs) is generally smaller than that observed in most other species of marine turtles, however leatherbacks clutch an average of 6 times per nesting season. Nesting occurs every two to three years.

Discussion

It was asked if leatherbacks eat solely jellyfish, to which it was replied that they eat primarily jellyfish, being Cyanea sp and Aurelia off Eastern Canada and different species elsewhere. Leatherbacks are known to ingest a wide variety of schyphomedusae, siphonophores, salps, etc. as well. This likely influences their distribution. It was asked when is the nesting season in the Atlantic. The peak is in April – May. When exactly are leatherbacks off our coast? Most reports of turtles are made between the months of May and November, although there are likely turtles present in Canadian waters in lower numbers throughout the year. It is not known whether or not juveniles occur here although this is highly unlikely. Four of five turtles tagged inshore remained inshore in Canadian waters before assuming a southward migration. While temperature likely influences distribution, it is not as profound a factor as in other turtles (e.g. loggerheads). Leatherbacks can maintain their core body temperature as much as

18 C above ambient. How is the data recorded? Generally by volunteers and individuals working on a variety of different projects. Participants felt that there is a need for establishment and support of an Atlantic zonal database of turtle sightings, into which individuals and / or organizations would place their sightings' information as and when it is collected.

- An Atlantic zonal database of turtle sightings off Canada's East Coast needs to be established and supported.

The most cost-effective way to get sighting information is to work with the fishing industry. Maps (appendix 5) providing an overview of turtle distribution in Canadian water were presented. These were a compilation of records from all Atlantic provinces, including recent data from James (1999). They showed that turtles are found in many areas off the coast from Georges Bank to Labrador, with significant data gaps on the Scotian Shelf and off Newfoundland. However, even in areas of high fishing pressure, they are rare in the Bay of Fundy and only few observations have been made in the Gulf, indicating turtles might not frequent these areas as much as others.

There is a seasonal movement up the East Coast, as confirmed by NMFS aerial surveys, observer coverage, etc. It was questioned if we should survey the population. Yes, collaboratively with the US. Dependence on sighting data from the fishing industry will always be biased by fleet distributions. However, it might be cost effective to survey leatherbacks along with other species. For instance, the NMFS survey collects information on basking shark, whales, turtles, etc. The nature of the survey activity (aerial vs. satellite tracking) was discussed at the end of the meeting.

There was discussion on the listing process. Ridley turtle is highly endangered and COSEWIC would review leatherbacks in April 2001. Neither loggerheads nor Ridleys are listed by COSEWIC. It was noted that the COSEWIC process can be 'hit or miss' re species being listed as it depends upon who is available to conduct a review.

OVERVIEW OF THE EAST COAST FISHERIES BY GEAR TYPE (M. SHOWELL and D. KULKA)

Presentation Highlights

An overview of the distribution of fleet effort by season on the East Coast was provided, based upon data in the Zonal Interchange Fisheries (ZIF) file, plus observer data where appropriate. This overview included

- landings data from all Atlantic regions
- Near set-by-set, geo-referenced information
- Data from 2000 with other years used where most recent picture not representative
- Observer data presented where no landings available
- Mobile gear, Fixed gear, Invertebrate gear, inshore and offshore
- A series of distribution maps by quarter

The level of observer coverage was briefly reviewed. It was noted that the percentages are expressed as per landings, rather than effort, which is more appropriate. However, it is harder to do by effort due to data limitations.

Observer Coverage – Previous (1987-97) Scotia-Fundy (SF) & Newfoundland (NF)	
1) Foreign vessels	100%
Large pelagic	
Groundfish various	
2) Northern Shrimp	100%
3) Large Mobile Fleet	~ 40%
4) Porbeagle shark	20-40%
5) Small vessel (Mobile, Fixed)	2-10%
Observer Coverage – Current (SF)	
1) Foreign vessels	100%
- Japan tuna	
- Cuba silver hake	
2) Northern Shrimp	100%
3) Georges Bank	10-15%
- Groundfish	
4) Most fisheries	~5%
- ITQ mobile < 65'	
- Fixed longline < 65'	
- CDN silver hake	
- LG mobile	
- CDN pelagic longline	
5) Limited coverage	
- gillnet	1%
- offshore lobster	< 1%
- fish trap	0%
- porbeagle shark	0%
Observer Coverage – Current (NF)	
1) Foreign vessels	100%
2) Canadian fisheries	
- Northern Shrimp (offshore)	100%
- Northern Shrimp (inshore)	10%
- Yellowtail	100%
- Groundfish (mobile and fixed)	2-10%
- Crab	40%

It was noted that the silver hake fishery utilizes a grate that acts likes a TED (turtle exclusion device) and thus turtle by-catch is likely not a problem. The groundfish longline fleet for halibut, in particular, operates along the Shelf edge where turtles might be expected. The pelagic longline fishery targets tuna, swordfish, and shark, and has the potential to interact. The Japanese Tuna fishery has a lot of data available since 1980 and 100% observer coverage since 1987. The porbeagle fishery is operated through a Joint Project Agreement (JPA) and

the information does not get back to the observer program. It was felt that this information should be centrally stored. It was noted that observer coverage on the shark fishery was higher when it was a foreign fishery. More observer coverage of the Canadian fishery is required.

The gillnet fishery operates mostly in the Gulf of Maine (GOM) area and 4T. Positions and effort are not recorded in Newfoundland although they are reported. It was considered that they should be. It was questioned whether or not a gillnet exclusion zone might be required in 4VW if turtles are a problem. The pelagic gillnet fishery is very small.

The offshore lobster fishery operates in 4X/5Z, at a time when turtles would be occurring, while that of the inshore in 4X operates during Nov – June, generally a time when turtles would not be in the area. However, it was noted that access to these data is difficult and there is a need for a central database.

Regarding snow crab, the fishery operates in 4VW, 4T and 3L, using pots with lines during April – September. Thus the potential for interaction with turtles exists.

Regarding shrimp, it operates in 4VsW, the Gulf estuary and in 2J3K, using a shrimp trawl. The potential for interaction exists. It has 100% observer coverage on the offshore and 10% on the inshore.

Regarding trap fisheries, there is a little fishery in 4X for mackerel and cod. It is small now in Newfoundland, although there are some along the coast. Pelagic traps are not used in Nova Scotia but are used for capelin off Newfoundland during July – September.

Discussion

There was discussion on the most appropriate measure of observer coverage – days, trips, landings. This would depend upon the objective, but it was felt to be effort in this case. It was noted that observer coverage during 1987-97 was higher than now. It is now negotiated. Are all turtle by-catches recorded? Prior to 1999, if a turtle came on board (a relatively rare event), its weight was recorded. Since then, the number and species of turtles caught is recorded. However, species identification could still be problem when a turtle comes to the side and is cut away. It would be recorded as turtle not specified (NS). There was discussion on whether or not fishing behaviour changes with observer coverage. It might.

It was noted that a number of gear types were not mentioned in the presentation e.g. scallop dredge. In these cases, it was felt that the degree of interaction was potentially limited. It was agreed to include a table listing all gear types and their potential interaction with turtles. This is provided in the last section of these proceedings.

Is a TED used in the silver hake and northern shrimp fisheries? Not exactly, it is a Nordmore grate, to exclude non-target species that acts in a similar fashion. In these fisheries, in over 500,000 observed sets, no turtle catch has been reported.

It was noted that in the US, green turtles, which rest on the bottom, are caught by scallop dredges. Thus, there is the potential for interaction but perhaps not as important as with other gears.

What about weirs? The gear entrance is small, but they also catch large sharks and whales, so as a gear, they might have the potential to catch turtle. However, these are mostly in the Bay of Fundy, where turtles don't seem to occur.

It was noted that S. Brady and J. Boreman (1996) conducted an evaluation of turtle catch by different gears in the US.

Overall, there are many fisheries that could potentially interact with turtles, except for weir (wrong area), lobster in Southwest Nova Scotia (wrong season), and bottom trawl (turtles not on bottom). There was discussion on the latter. A table of US turtle catches by gear was tabled. In the US, for instance, gillnet catches of turtles depend upon the water temperature. There may be a temperature connection. There are significantly colder bottom temperature year round in Canada which could reduce turtle abundance on the bottom and thus the degree of interaction with bottom operating gear types.

OBSERVATIONS FROM TRAWLING
(J. McMILLAN)

Presentation Highlights

A data inventory was undertaken to determine if DFO had any information on marine turtle incidental by-catch in either of the trawl fisheries data sets or the trawl surveys data set. The data sources examined included: Commercial Landings, Industry Surveys (Observer Program) and the Groundfish Trawl Research Surveys. Additionally, interviews were conducted with long-term employees of DFO – people that have been directly engaged with the commercial fishery as well as representatives of non-governmental organizations. Overall, there were no observations of marine turtle incidental catch occurring.

The commercial landings data set does not record by-catch data but the personal interviews corroborated that the trawl fisheries do not interact with sea turtles. The industry surveys data set records marine turtle by-catch and no observations were made. The offshore shrimp fishery has 100% observer coverage. The other trawl fisheries have 5% coverage. The DFO groundfish trawl survey data set records marine turtle catch data but no observations were made. All of the people interviewed stated that they were not aware of any interactions between marine turtles and the trawl fisheries in Canadian (primarily Bay of Fundy and Scotian Shelf) waters. Other meeting participants from Newfoundland corroborated this fact.

The conclusion of this investigation is that the trawl fisheries do not interact with marine turtles in Canadian waters.

The presenter made the following recommendations:

- The monitoring of trawl fisheries for turtle by-catch should be continued.
- The observers deployed to all fisheries should be trained and instructed to identify sea turtles to species

- Turtle incidental catch events, observed in the Industry Survey Program, should be documented using expanded and standardized protocols
- Commercial fisheries datasets should be expanded to include incidental catch events of turtles

Discussion

The US observations showing that loggerheads are taken in trawls was reiterated. Apparently, loggerheads feed on the bottom and, as mentioned above, bottom water temperatures off the Canadian East Coast are relatively low and could be preventing loggerheads from feeding on the bottom in these waters. Leatherbacks in the US are caught in trawls but only in southern waters (NMFS fall survey). The consensus was that while trawls do not interact with turtles, continued monitoring is required.

OBSERVATIONS FROM INSHORE AND OTHER FISHERIES
(J. LIEN and D. MCALPINE)

Presentation Highlights

The presentation focused on what information is available on turtle by-catch in inshore fisheries. Much of the information comes from the entrapment and stranding assistance program in Newfoundland and Labrador (it was noted that in the US, the stranding program is different). The program was initiated to record whale sightings and other species such as turtles. One has to be careful interpreting the sighting information as only a small number of incidentally-caught animals may be reported and not all of these are recorded due to accuracy concerns. Some turtles have been released without recording. These are thus minimum estimates. 91 incidents of turtle by-catch were recorded (40% died, 60% released) in gillnets, trawls, herring nets, salmon gillnets, cod traps and crab gear. Most by-catch is by entrapment and mortality occurs before a fisherman visits the gear. Where possible, fishermen release the turtles, with intentional kills rare. By-catch probably occurs off Newfoundland year round but is most coincident with the warmest part of year. Consistent with a turtle's feeding behaviour, most sightings are coincident with jellyfish. It was noted that there is still a motivation to bring caught turtles home 'to show everyone'. Turtle conservation needs to be taken seriously at all levels, from the communities to DFO. However, progress is being made. On the other hand, off Trinidad, 10% of the females were caught and killed, as turtle meat brings a good price. There is a need for the Canadian International Development Agency (CIDA) to work with Caribbean governments to reduce turtle mortality.

The presenter made the following recommendations:

- Community education programs on turtle conservation need to be undertaken
- Assistance should be provided to fishermen to help them to conserve turtles
- The Newfoundland sighting program should be continued
- Cooperative research efforts with fishermen on turtles should be developed
- Canada should work with southern authorities (Caribbean) to mitigate limiting factors of the turtle populations

It was noted that we are in transition with the Canadian Species at Risk Act (SARA) being considered by parliament; the communities need time to adapt to this. Also, there are no plans to continue the Newfoundland entrapment program, which should be institutionalized using SARA funding.

Discussion

All the observations were from the inshore. It is suspicious that turtles are not being reported from the offshore. This may be related to disproportionate by-catch by particular fleets in the offshore. There was a question on how exactly turtles get entangled. They are frequently caught in the lines rather than in the nets themselves. They are caught during the hauling of the gear and thus how they are caught may be related to how they feed. Therefore, any kind of mooring would be a potential source of entanglement. It was noted that in the US turtles can be caught in surface drift gillnets. The more loosely these are hung, the greater the probability of catch. There is a need to know where in the water column in Canadian waters turtles predominantly reside.

- Studies need to be undertaken to determine the vertical distribution of turtles in Canadian waters

To truly understand the entanglement process, photographs of turtle scars (on flippers, etc) might be useful. However, this would only show those turtles that survived and it is very hard to determine the source of injury from a photograph. It was felt that stiffening lines and less gear at the surface are a key to reducing entanglement, as corroborated by anecdotal reports from the industry. Ongoing U.S. longline gear experiments may result in gear modifications that could be transferable to fixed gear interactions in both Canadian and U.S. waters.

It was asked if there was any link between the stranding system in Nova Scotia and in Newfoundland. There is both a whale stranding and turtle stranding network in NS. The former has collapsed but is trying to be revitalized. There are no facilities for rehabilitation, and just release is occurring. Calls are handled through the Canadian Coast Guard. It is not on the Newfoundland scale but is volunteer. In New Brunswick, efforts are underway to get a stranding network going. In the US, there is a very extensive network, with state coordinators from Maine to Texas. There are a lot of strandings (2-300 per year primarily south of Virginia) in the US. Although there is standardized stranding data collection and NMFS maintains the stranding database, it is important to clarify that while NMFS provides some limited funding for the program, NMFS does not support the Sea Turtle Stranding and Salvage Network.

NMFS currently has an established, operative disentanglement team for whales in the Gulf of Maine and is considering setting up a similar disentanglement team for turtles, since this is still needed to address sea turtle interactions with fixed gear; it would like to follow up with Canada on this. There is SARA funding (Habitat Stewardship Program) that could be used to set up a like team in Canada but it has to be directed by a recovery team or like jurisdiction. DFO would have to collaborate with outside interests to set this up. It was noted that, from a fisherman's perspective, disentangling leatherbacks is very easy. Fishermen don't need help. What is required are education programs on the need for conservation, as mentioned above.

Also, it is extremely important to gain a better understanding of how they are disentangling animals (are the animals completely free of gear when released?) to provide written guidelines to fishermen, to fully document each interaction and to obtain photos and biological samples when possible. Overall, the establishment of a stranding network was not considered a priority but rather, we should work with fishermen to encourage them to report turtle by-catch. This is mentioned that this could be difficult because such observations could be perceived as being eventually used to limit fishing behaviour (e.g. US box off Grand Banks). Overall, though, fishermen are one of the most important sources of information.

OBSERVATIONS FROM PELAGIC LONGLINING (S. SMITH)

Presentation Highlights

Tables of observer coverage and the number of trips conducted in the Canadian pelagic longline fishery were presented. The observations focused on the catches of all species (rather than just turtles) in the domestic fishery, in which observer coverage has been 4 – 9% in recent years. The Scotia-Fundy (SF) database includes landings in Newfoundland. There are also reports available from some Newfoundland vessels (about 10% of the Newfoundland licenses) but these were not included in the presentation. The observer coverage was presented by month. It was pointed out that the current fishery is primarily directed on tuna rather than swordfish, with a change occurring between 1998-99. Bigeye tuna generates more revenue than swordfish (more by weight for swordfish but more by numbers for tuna). Regarding the Japanese data, only that within the 200-mile limit is in the DFO database. The International Commission for the Conservation of Atlantic Tunas (ICCAT) has the rest.

A table of catch rates (no / 1000 hooks) of all species from the 1999 and 2000 observer data was provided, as these two years provided the only useable data. Hardshell turtle catch rates varied substantially between the two years. It was quite evident that more data is required to understand the turtle – fishery interaction.

The following observations were made by the presenter:

- There is a need to improve observer coverage
- DFO needs to work with industry to improve knowledge of turtles
- There is a need to estimate mortality rates as a result of by-catch
- More biological knowledge is needed on more species

Discussion

There was discussion on the Japanese fishery, which fishes at different times of day and year than the domestic fishery. It has always been a tuna directed fishery, with the Canadian fishery just recently becoming so, as stated above. It uses very different gear (Canadians use circle hooks), fishes deeper during the day (targeting tuna as opposed to the shallower swordfish fishery at night) and is prosecuted during November – January (domestic fishery is during June – Oct).

It was noted that the list of species caught in 2000 was more extensive than in previous years. This was felt to be related to the current identification of species in the 'Not Specified (NS)' category.

It was mentioned that the US is updating their observer guidelines and training to include turtle handling. Although targeted at trawl and longline gear, they could be useful for Canada.

- The US observer protocol for turtle handling should be considered for the Canadian observer program. The US may be able to assist in training as well.

The question of observer coverage was raised. It was pointed out that the 9% coverage level may be adequate but this requires further examination given the observed interannual variability (e.g. temporal and spatial distribution, variation in relation to trends, etc). The level depends to a great extent upon the question being asked. There was the sentiment that we should extract as much information as we can from what we have first before increasing coverage.

GLOBAL BY-CATCH ANALYSIS (R. MYERS)

Presentation Highlights

The presentation was based on a US commissioned report, which examined global trends in by-catch of turtles, particularly by pelagic longline gear. It was pointed out that for leatherbacks, big declines in the numbers at nesting beaches have been observed. While the numbers in Florida have gone up, this is counteracted by large declines in South America. The introduction of TEDs in 1989 was considered a positive conservation measure for turtles. The report focused on information subsequent to 1989 due to data problems.

According to the report, leatherback US catch rates (no. per set) off Newfoundland were higher than in other areas and were the highest in July (one turtle per set). Catch rates for loggerheads showed similar trends. The highest catch rates were noted in the late summer / early fall, consistent with what is known about seasonal migrations of turtles. The best predictor of turtle by-catch on the Grand Banks appeared to be the catch of swordfish. The study did not attempt to judge impacts of this by-catch on the turtle populations. Strong interannual differences in catch rates were reported with no evident correlation with other factors.

It was mentioned that the report is currently being distributed for peer review.

Discussion

There were questions on the number of US trips observed in the study. It was noted that the US catch rates seemed higher than those observed in the Canadian fishery during 1999 – 2000, as reported above. Understanding the differences between the catch rates of the two countries could be very important as before 1998, in the Canadian fishery, turtles were classified as NS. This would be a useful comparison as long as the operations of the two fleets were similar. The discussion then focused on the operational characteristics of the two fleets.

The Canadian fleet uses short buoy drops (four fathoms to the main line) and leaders, with three hooks between buoys. The US fleet, similar to that of Japan, uses longer leaders and different types of line and generally fishes deeper than the Canadian fleet, although it fishes at about the same time and in the same general area as that fleet. Different hooks and bait (mackerel vs. squid) are also used. These operational differences could influences the catch rates but it is uncertain as to how.

- To understand the differences between the Canadian and US pelagic longline fisheries, a detailed comparison of the 1999 and 2000 catch rates needs to be undertaken

There is no doubt that the pelagic longline fishery interacts with the turtle population. However, the impact of this interaction on the population is uncertain. In the Canadian fishery, for instance, based on reports from observers and the industry, close to 100% of the turtles caught are released alive, and thus the impact may be slight. However, the eventual fate of these released turtles is unknown. This would be somewhat dependent upon the catch and release process. The observers have not been recording how exactly the turtles are being entangled and released.

- The Canadian East Coast observer program should collect information on how turtles are caught i.e. entangled, mouth-hooked, hook swallowed, etc. Protocols for the observations need to be established.

US OBSERVATIONS
(B. SCHROEDER and C. RYDER)

Presentation Highlights

In the US, the gear of concern in relation to turtles are trawl (bottom and midwater), gillnet (large & small mesh), longline, pots (lobster, crab and whelk), pound nets (weirs), purse seine, hook and line, and dredge. A number of data sources exist including observer, logbook, stranding (reports of dead or injured turtles), intercept & questionnaire, experimental (mortality and gear research) data, and enforcement information. Observed fisheries extend from the Northeast US to the Gulf of Mexico; coverage (% of effort) is at or below 5%. The following table provides information on gear types of concern, qualitative prioritization of the impact, status of observer programs, and relevant regulatory actions:

Gear	Impact?	Observers?	Regulatory actions (Mag Act & ESA)?
Trawl	H	YES	TED's, time/area closures
Gillnet	H	YES	Prohibitions, time/area, gear regs
Longline	H	YES	Handling requirements, closures, move after interaction (no protocol yet)
Pot/trap	M/H	YES	None
Pound net	M	NO	time/area closures and mesh size restrictions
Purse Seine	L	YES	None
Hook & Line	L/M	NO	None (localized impact)
Dredge	L/M	YES	None

Some of the factors that affect the interaction with turtles are trawl tow time, gillnet soak time, greater gear depth, large mesh size, tie downs, large mesh size in leader (pound nets), pot/trap slack lines and more gear at surface.

Determining the post-interaction fate of turtles hooked or entangled in longline fisheries is difficult. While several studies provide useful information, there are a variety of opinions on the interpretation of these data. NMFS reviewed all available information on the issue of post-hooking mortality and solicited input from veterinarians and sea turtle physiologists prior to developing a policy memorandum on this issue. The following draft table summarizes the decisions made by NMFS on how it will interpret post-interaction mortality, until further information becomes available that will allow refinement of these conclusions. NMFS is contemplating a workshop on this topic in late 2001.

Type of Hooking	Post-capture Mortality, %
No hooking , no injury, disentangled completely	0
Hooked externally or entangled, line left on animal	27
Mouth hooked or hook ingested	42

NMFS funded a study in 2000, conducted by the University of Florida, Archie Carr Center for Sea Turtle Research, to evaluate three hook types in relation to loggerhead turtle capture in the eastern Pacific, around the Azores. Three hook types were studied – J, offset J and circle (0/16). The hook types were alternated on the longline string. Turtle and target species catch was evaluated over 93 sets, during which 237 turtles were caught. No significant differences in the numbers of loggerheads caught by hook type were observed. There was a significant difference in the location of the hooking, with circle hooking significantly more in the mouth (81%) versus the J hook (57% ingested).

NMFS has funded or conducted several preliminary experiments with captive turtles to examine the effects of certain longline gear components. Experiments evaluating attraction to lightsticks, bait colour, and tainted bait have been conducted or are underway. Future studies could look at a number of potential modifications to gear to decrease turtle by-catch while not impacting target species catch rates, including larger circle hook (Canadian fleet currently

uses a circle # 16), use of offset circle hooks, branch lines longer than float lines, bait type, branch lines away from floats, use of light sticks, stiffened leaders, etc).

There was then presented some thoughts on how Canada and the US could collaborate. One area is the standardization of observer training and data collection. Another is collaboration on disentanglement networks and protocols. Collaboration on gear experiments and the coordination of aerial surveys are also potentials. Finally, the two nations should continue to exchange information on turtles.

The presentation ended with a description of the Inter-American Convention for the Protection & Conservation of Sea Turtles (1996), which was ratified by the US in Feb 2001 (the website address is http://www.seaturtle.org/iac/intro.shtml). This is the first multi-lateral agreement in the world dedicated to turtle protection, conservation and recovery. When the convention was first drafted, the importance of Canadian waters to sea turtles was not appreciated. However, it is becoming clear that East Coast waters are important for sea turtles and Canadian involvement in this Convention would be valuable, and should be explored.

- Canada's involvement in the Inter-American Convention for the Protection & Conservation of Sea Turtles would be valuable and should be explored.

Discussion

There were some questions on the protocols on moving the fishing location of gear. The observation was made that loggerheads go after bait, while leatherbacks don't. This could explain why loggerheads are more frequently entangled in fishing gear than leatherbacks. It was pointed out that the Canadian observer data forms do not currently record hooking type, thus requiring a change in the protocols, as mentioned earlier.

QUESTIONS TO ADDRESS

What fisheries (trawl, gillnet, trap, longline, etc) interact (past, present and future) with the turtle populations?

Any gear with line can impact turtles through entanglement. There is a difference between the capture of leatherbacks and loggerheads, perhaps related to diet. Loggerheads tend to be mouth hooked more than leatherbacks. An overview of potential interaction by gear and fishery is given in the following table, based on the comments and observations made at the meeting. It should be pointed out that in many cases, the potential for interaction was considered low due to the temporal and spatial distribution of the fishery. In other cases, there is the potential for interaction, but in many cases there is little or no observer information to document whether or not interaction is occurring.

Gear	Targeted Species	Area / Season	Comment	Potential for Interaction?
Longline	Groundfish	All areas & seasons	Hooks set close to bottom but entanglement a concern	Yes
	Pelagic	Atlantic Coast	Observations available	Yes
Gillnet	Herring	Newfoundland	Bait fishery; not regularly tended	Yes
	Herring	4T	Entanglement a concern but turtles not in 4T	Low
	Groundfish	5Z	Cod fishery	Yes
	Mackerel	4T	Bait fishery ; not many leatherbacks enter Gulf	Low
	Mackerel	4X	Bait fishery all year	Yes
Dredge	Scallop / Clam	Subarea 4; all seasons	Bottom temperatures below 10 C.	Low
Trap	Lobster	Nfld (May – June)	Limited season	Low
	Lobster	4T (May – Oct)	Entanglement a concern but turtles not in 4T	Low
	Lobster	4VW (May – July)	Limited season	Low
	Lobster	4X inshore (Nov – June)	Outside of turtle season	Low
	Lobster	4VWX5Z Offshore	Turtles in this area	Yes
	Groundfish / Pelagic	All areas & seasons	Entanglement a concern	Yes
Pot	Snow Crab	3L (April – Sept)	Entanglement a concern	Yes
	Snow Crab	4T (April – Sept)	Entanglement a concern but turtles not in 4T	Low
	Snow Crab	4VW (April – Sept)	Entanglement a concern	Yes
Trawl	Shrimp	2J3K	Nordmore grates	Low
	Shrimp	4VsW	Nordmore grates	Low
	Groundfish	All areas & seasons	Bottom temperatures below 10 C.	Low
Purse Seine	Herring	All areas & seasons	Entanglement not a concern	Low
Weir	Herring	Bay of Fundy	Turtles not in bay	Low
Other gears *	Various	All areas & seasons		Low

* Lampara, jigger, troller line, handline, rod & reel, lift net, hand dredge, rake & thong, beach & bar seine, harpoon, seal hunting

What does the available information state about the spatial and temporal (annual and seasonal) distribution of turtle by-catch? Observer and anecdotal? How reliable is this information?

Leatherbacks occur off the Canadian Atlantic coast during late June – Oct (peak period). They are generally not observed in the Bay of Fundy and only few records have been made in the Gulf. There are some reports from the West Coast of Newfoundland. Regarding loggerheads, there is a similar pattern but they may stay later in the season, dependent upon the Gulf Stream. No green turtle have been seen in Canadian waters and there have been only five records for Ridleys (during Aug. – Sept). Regarding reliability, almost all Canadian turtle reports have been anecdotal, except in the case of the pelagic longline fishery, where observer records are available. The fact that relatively few of the potentially interacting fisheries is currently being observed is a major source of concern. It should be noted that the NMFS shipboard and aerial survey data is another source of reliable information.

For pelagic longline fisheries, what by-catch species are caught, what are estimates of the by-catch and how reliable are these estimates?

There are only two years (1999 and 2000) of reliable Canadian observer information, and these exhibit considerable interannual variability. US observer data is available and may assist explanation of the turtle – fishery interaction. However, the differences in fishing operation between Canada and the US may be significant and confound this comparison. As recommended above, there is a need for a detailed comparison of the US and Canadian observer data existing for the same time and area. Regarding the historical Canadian observer data, the meeting considered that it would be useful to undertake a turtle presence / absence analysis.

- The historical Canadian pelagic longline fishery observer data should be subjected to a presence / absence analysis

Is there any information available of turtle survival from different gear types?

There is only the US data from the three studies that is available. There are considerable differences among the experts on the implications of the observations. While the US policy statement for all turtles was based on these data, the studies were conducted primarily on loggerheads. No leatherback data (except some for pot gear) is available. Notwithstanding this, the policy was seen as a useful means to scale fishery impacts on turtles. It was noted that there is no precise quantification of the impacts of various gears and that considerable funding would be needed to achieve this. It was questioned whether or not this would be a useful exercise.

Based on the information available, what fisheries, times and seasons show the most potential for interaction with the turtle populations? Will it be possible to make statements and management recommendations about the overall impact of the fisheries in the Canadian zone on turtles? (this will decide whether or not a future RAP is warranted).

The first part of the question was addressed above. Overall, while there is volunteered information for some Canadian fisheries, it is only for that of the pelagic longline that observed data is available. There is limited or no information on the type of entanglement in the various fisheries. As reported above, in the pelagic longline fishery, based on reports from observers and the industry, close to 100% of the turtles caught are released alive. However, the eventual fate of these released turtles, which would be somewhat dependent on the catch and release process, is unknown. Before making statements on impacts, there is a need for the collection of more information on the turtle – fishery interaction and the follow-up analyses as recommended at this meeting. It was considered that a RAP meeting in 2001 to evaluate the impacts of fisheries on the turtle population would be premature and that such as meeting should be delayed 2 – 3 years, after which time the appropriate information would hopefully be available.

- A RAP meeting to evaluate the impacts of fisheries on the turtle population should be delayed 2 – 3 years, after which time the appropriate information would hopefully be available

What are the information gaps and what are recommendations to collect the appropriate information?

The recommendations made at the meeting are provided in Appendix 6. It is structured by the themes discussed at the meeting. Besides the recommendations discussed above, this list includes two further recommendations discussed at the end of the meeting.

During the meeting, it was suggested that turtle surveys could be jointly conducted with the aerial marine mammal surveys. For instance, NMFS aerial surveys in Canadian waters are flown for harbour porpoise at an altitude of 500 ft. At this altitude, in good sighting conditions, it is possible to clearly distinguish leatherback and loggerhead turtles. It becomes more difficult to identify turtles at higher altitudes i.e. 750 ft of US right whale survey. In either case, however, one would only obtain a surface index, which would be of limited utility. Satellite telemetry studies would enable us to better understand the ecology and behaviour of leatherbacks in northeast waters and to help us identify migratory corridors in the Atlantic.

- The leatherback turtle populations off Canada's East Coast should be surveyed, collaboratively with NMFS. The use of satellite tagging is preferred since a variety of information on turtle biology would be obtained.

As pointed out a number of times in the meeting, observer coverage is only present in one fleet sector, with other fleets that show a potential for interaction not covered.

- Observer coverage should be expanded to areas and fleets where information is lacking.

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Appendix 1. Meeting Terms of Reference

Leatherback and loggerhead turtles frequent East Coast waters and become entangled in fishing gear. Leatherbacks are considered an endangered species and thus it is important for DFO to evaluate the impact of this interaction and what measures can be taken to avoid turtle mortality. However, the database is very weak and thus it is necessary to define what we know and make recommendations to fill the knowledge gaps. As well, this information is needed to decide whether or not management advice can be given through RAP.

There is also a desire to document the by-catch of all species, not just turtle, in the pelagic longline fisheries.

A meeting will be held to consider:

1. What fisheries (trawl, gillnet, trap, longline, etc) may interact (past, present and future) with the turtle populations?
2. What does the available information state about the spatial and temporal (annual and seasonal) distribution of turtle by-catch? Observer and anecdotal? How reliable is this information?
3. For pelagic longline fisheries, what by-catch species are caught, what are estimates of the by-catch and how reliable are these estimates?
4. Is there any information available of turtle survival from different gear types?
5. Based on the information available, what fisheries, times and seasons show the most potential for interaction with the turtle populations? Will it be possible to make statements and management recommendations about the overall impact of the fisheries in the Canadian zone on turtles?
6. What are the information gaps and what are recommendations to collect the appropriate information?

It is important to note that this meeting is primarily intended to consider what data are available on the above issues, rather than be a review of analyses. The latter, if deemed possible, would be the focus of a future, likely RAP, meeting.

Products

CSAS Proceedings, including recommendations

Appendix 2. List of Participants

Participant	Affiliation/Address	Telephone	FAX	E-Mail
Troy Atkinson	N.S.S.A.	(902) 457-4968	(902) 457-4990	Hiliner@ns.sympatico.ca
Jerry Conway	MASARO, DFO	(902) 426-6947		Conwayj@mar.dfo-mpo.gc.ca
Gretchen Fitzgerald	Dalhousie University	(902) 453-9228		Fitzgerg@is2.dal.ca
Lei Harris	MFD, DFO	(902) 426-2298	(902) 426-1506	Harrisle@mar.dfo-mpo.gc.ca
Mike James	Dalhousie University	(902) 494-6182	(902) 494-3736	Mjames@mscs.dal.ca
David Kulka	NWFC, DFO	(709) 772-2064	(709) 772-5469	Kulkad@dfo-mpo.gc.ca
Jon Lien	Memorial University of Newfoundland	(709) 753-5495	(709) 737-2450	Jlien@mun.ca
John Loch	MASARO, DFO	(902) 426-5929		Lochj@mar.dfo-mpo.gc.ca
Don McAlpine	New Brunswick Museum	(506) 643-2345	(506) 643-2360	Dmcalpin@nb.aibn.com
Jim McMillan	MFD, DFO	(902) 426-3516	(902) 426-1506	Mcmillanj@mar.dfo-mpo.gc.ca
Odette Murphy	Resource Management, DFO	(902) 426-9609	(902) 426-9683	Murphyo@mar.dfo-mpo.gc.ca
Robert O'Boyle	RAP, DFO	(902) 426-3526	(902) 426-5435	Oboyler@mar.dfo-mpo.gc.ca
Cheryl Ryder	NMFS, NEFSC	(508) 495-2396	(508) 495-8066	Cheryl.ryder@noaa.gov
Barbara Schroeder	NMFS	(301) 713-1401	(301) 713-0376	Barbara.schroeder@noaa.gov
Mark Showell	MFD, DFO	(902) 426-3501	(902) 426-1506	Showellm@mar.dfo-mpo.gc.ca
Sean Smith	Contract Biologist	(902) 424-6494		Sean_c_smith@yahoo.com
Wayne Stobo	MFD, DFO	(902) 426-3316	(902) 426-1506	Stobow@mar.dfo-mpo.gc.ca
Gary Weber	Resource Management, DFO	(902) 426-1488	(902) 426-9683	Weberg@mar.dfo-mpo.gc.ca

Appendix 3. Agenda

Tuesday 20 March 2001

0900 – 0915: Introduction (O'Boyle)
Short introduction to go over the meeting terms of reference and agenda

0915 – 1000 Primer on Turtle Biology (Mike James)
Turtles are relatively new species to many of us. Mike will provide an overview of turtle biology to inform everyone on when and where they breed and lay their eggs, their seasonal movements and so on.

1000 – 1015 Break

1015 – 1100 Overview of the East Coast Fisheries by Gear Type (Mark Showell & Dave Kulka)
Dave and Mark will provide an overview of the temporal and spatial characteristics of the various East Coast fisheries to identify those which are most likely to interact with turtles. Also, this presentation could give an overview of the observer coverage (dockside likely not useful). As much as possible, all gear types will be considered (trawl, longline, trap, etc). This paper and that on turtle biology will hopefully give good indication on those gear types most likely to interact with turtles.

1100 – 1110 Observations from Trawling (Jim McMillan)
Jim has not located any information from this fleet sector. We will have a short discussion on this.

1110 - 1200 Observations from Inshore and other Fisheries (Jon Lien & Don McAlpine)
Jon and Don will enlighten us on the status of information on primarily inshore fisheries.

1200 – 1300 Lunch

1300 – 1400 Observations from Pelagic Longlining (Sean Smith / Julie Porter)
Sean has compiled the incidental catch information for the pelagic longline fishery, using all available sources.

1400 – 1500 Global By-catch Analysis (Ram Myers)
Ram has prepared an analysis of global by-catch trends in the longline fishery. While it does not contain Canadian data, it will provide a broader perspective on turtle by-catch.

1500 – 1515 Break

1515 – 1600 US Observations (B. Schroeder)
The focus of the presentation will be to provide information on sea turtles and their interactions with various gear types in U.S. waters, including information

on mortality as it relates to trawl fisheries, gillnet fisheries, and longline fisheries, to the extent that those data are available. An overview will be given of the actions, including observer programs that the U.S. has taken with regard to management of certain fisheries relative to sea turtle recovery and conservation.

1600 – 1700 Discussion

Wednesday 21 March 2001 (if necessary)

0900 – 1015 Review of the previous day's findings on the following questions from the Terms of Reference:

- What fisheries (trawl, gillnet, trap, longline, etc) interact (past, present and future) with the turtle populations?
- What does the available information state about the spatial and temporal (annual and seasonal) distribution of turtle by-catch? Observer and anecdotal? How reliable is this information?
- For pelagic longline fisheries, what by-catch species are caught, what are estimates of the by-catch and how reliable are these estimates?
- Is there any information available of turtle survival from different gear types?

1015 – 1030 Break

1030 – 1200 Discussion on the following questions from the Terms of Reference:

- Based on the information available, what fisheries, times and seasons show the most potential for interaction with the turtle populations? Will it be possible to make statements and management recommendations about the overall impact of the fisheries in the Canadian zone on turtles? (this will decide whether or not a future RAP is warranted).
- What are the information gaps and what are recommendations to collect the appropriate information?

1200 Adjournment

Appendix 4. List of Documents Tabled

James, M.C. 1999. Distribution of the Leatherback Turtle (Dermochelys coriacea) in Atlantic Canada: Evidence from an Observer Program, Aerial Surveys and a Volunteer Network of Fish Harvesters. MSc. Thesis. Acadia University. 72p.

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Showell, M. 2001. Spatial and Temporal Distribution of Total Landings by Fishery in Atlantic Canada during 1996 – 2000, based on the ZIF file.

Showell, M. 2001. List of Gear Types by Fleet for the Atlantic Fishery.

Smith, S.C. 2001. Examination of Incidental Catch from the Canadian Atlantic Large Pelagic Longline Fishery. Figures and tables from draft contract report.

Wynne, K. and M. Schwartz. 1999. A Field Guide to Marine Turtles and the Harbour Porpoise of the Northwest Atlantic Ocean. University of Rhode Island.

Appendix 5. Maps of Turtle Distributions on the Canadian East Coast (from McAlpine et al., 2001)

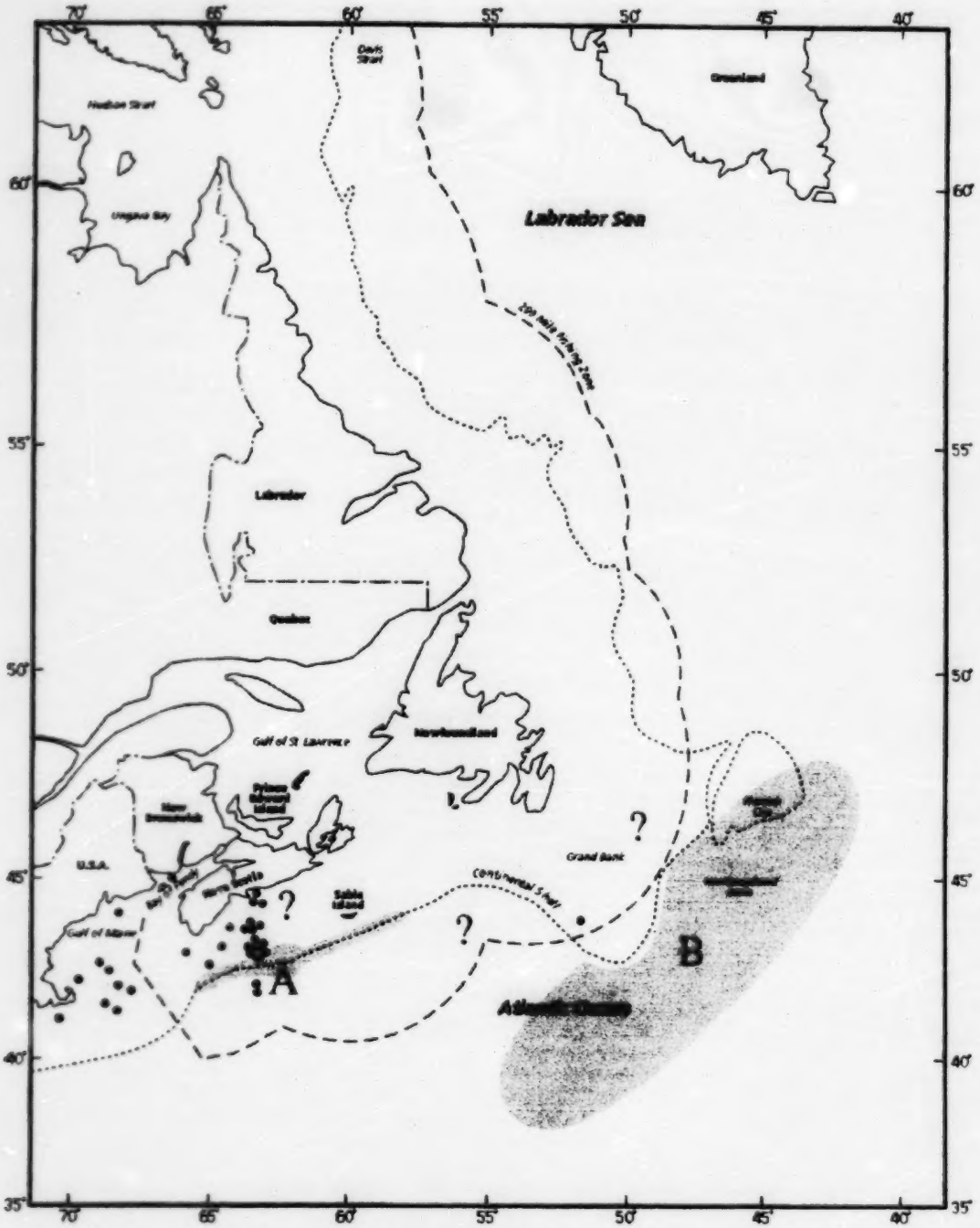

Figure 2. Occurrence of the loggerhead, *Caretta caretta*, off eastern Canada. Dots represent single occurrences and are based on published literature as well as unpublished sightings collected during 1999 NMFS aerial surveys. Shaded areas show the approximate location of concentrations of observations of cheloniid turtles believed to be loggerheads collected by participants in the Nova Scotia Leatherback Working Group ("A") or ("B") records of loggerhead long-line bycatch plotted by Witzell (1999). Question marks indicate areas in need of further study.

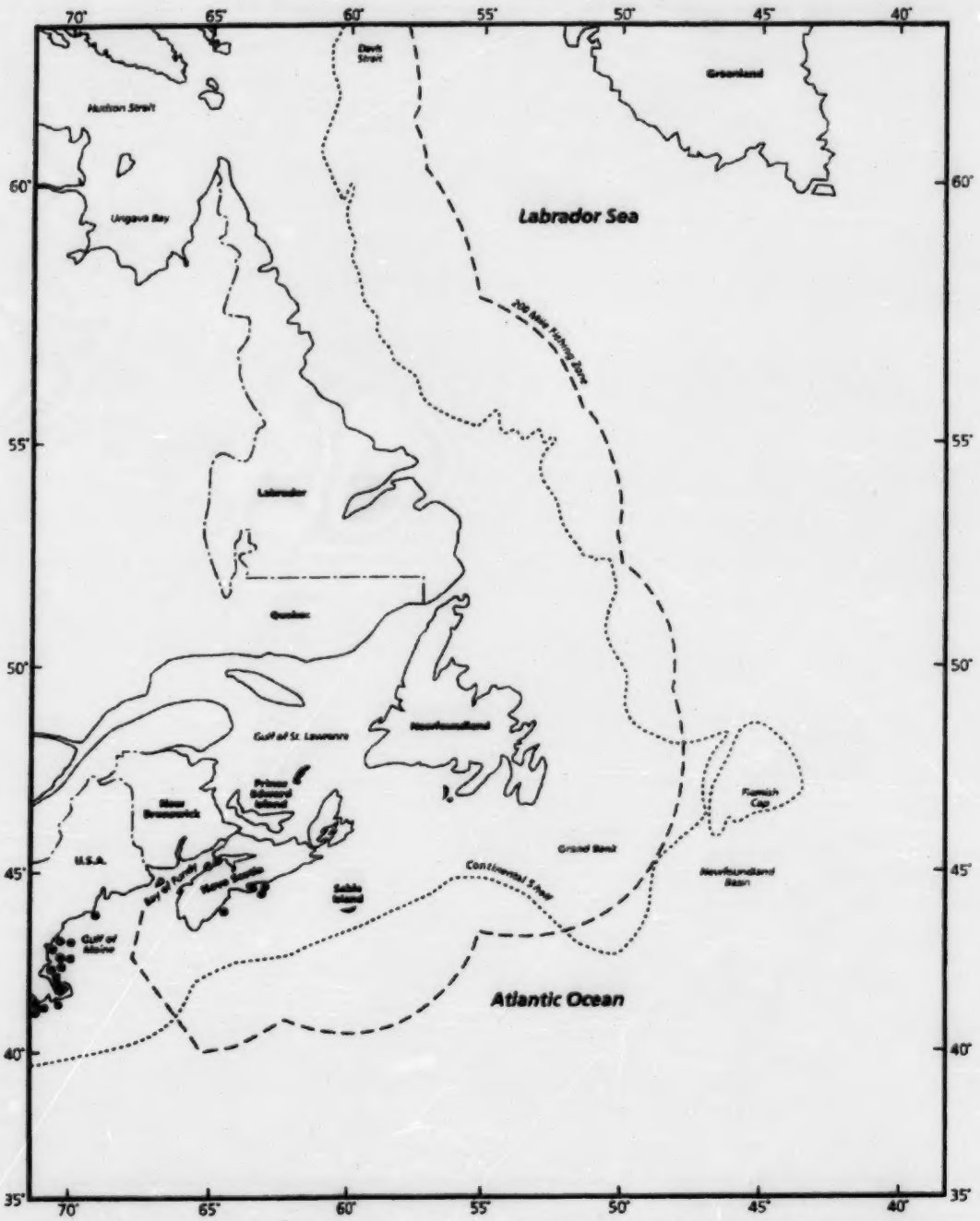

Figure 7. Occurrence of the Kemp's ridley, *Lepidochelys kempii*, off eastern Canada. Dots represent single occurrences and are based on published literature.

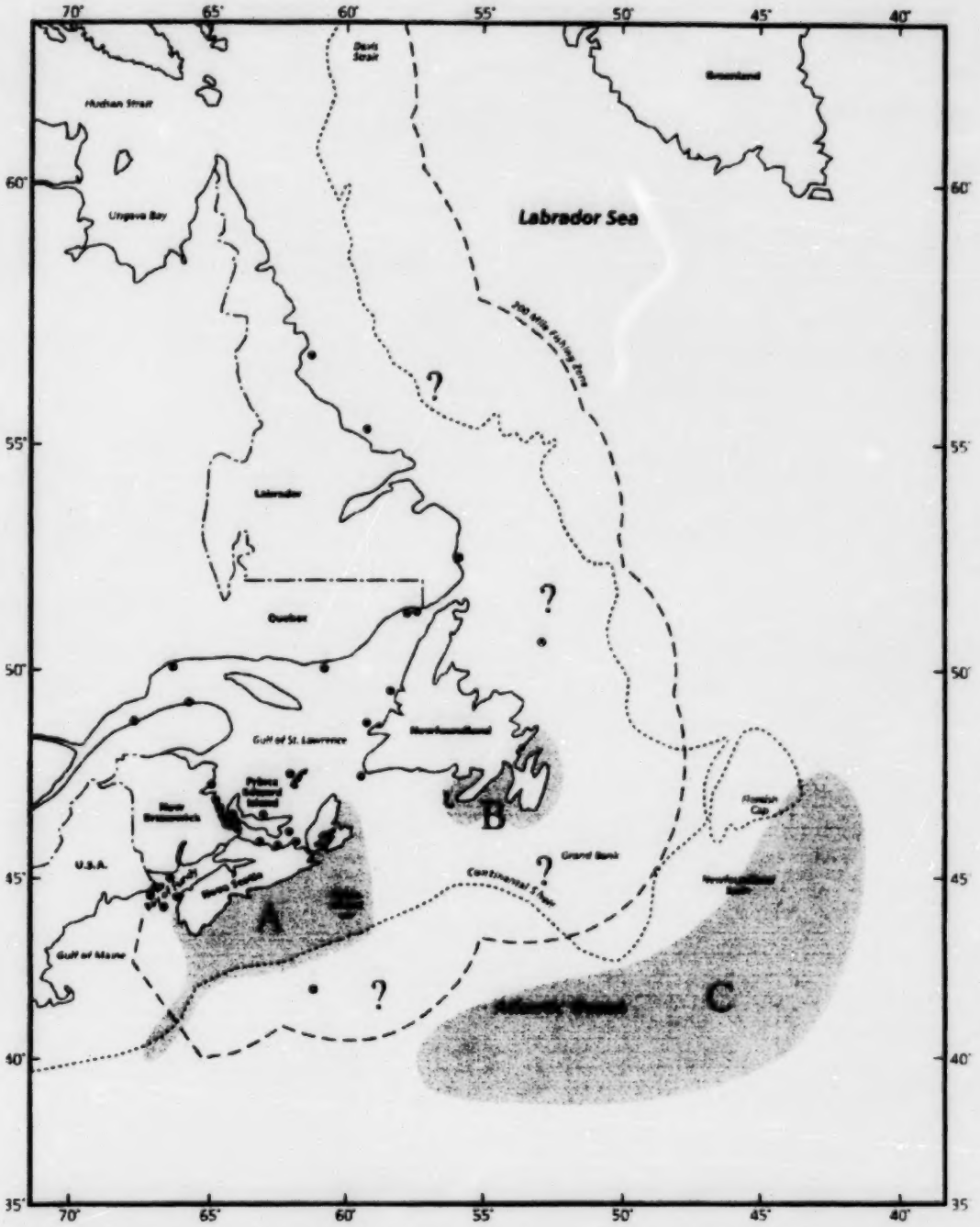

Figure 8. Occurrence of the leatherback, *Dermochelys coriacea*, off eastern Canada. Dots represent single occurrences taken from Table 3 and the literature. Shaded areas show the approximate location of concentrations of observations. Area "A" is based on James (1999), area "B' on Goff and Lien (1988), and area "C" on Witzell (1999). Question marks indicate areas in need of further study.

Appendix 6. Recommendations of the Meeting

Survey Programs and Research

- The leatherback turtle populations off Canada's East Coast should be surveyed, collaboratively with NMFS. The use of satellite tagging is preferred since a variety of information on turtle biology would be obtained.
- Studies need to be undertaken to determine the vertical distribution of turtles in Canadian waters
- Turtle incidental catch events, observed in the Industry Survey Program, should be documented using expanded and standardized protocols

Data Collection on Commercial Activities

- The monitoring of trawl fisheries for turtle by-catch should be continued.
- Commercial fisheries datasets should be expanded to include incidental catch events of turtles
- The US observer protocol for turtle handling should be considered for the Canadian observer program. The US may be able to assist in training as well. Also, the observers deployed to all fisheries should be trained and instructed to identify sea turtles to species
- The Canadian East Coast observer program should collect information on how turtles are caught i.e. entangled, mouth-hooked, hook swallowed, etc. Protocols for the observations need to be established.
- Observer coverage should be expanded to areas and fleets where information is lacking.

Data Processing

- An Atlantic zonal database of turtle sightings off Canada's East Coast needs to be established and supported.

Data Analysis

- To understand the differences between the Canadian and US pelagic longline fisheries, a detailed comparison of the 1999 and 2000 catch rates needs to be undertaken
- The historical Canadian pelagic longline fishery observer data should be subjected to a presence / absence analysis

Provision of Advice

- A RAP meeting to evaluate the impacts of fisheries on the turtle population should be delayed 2 – 3 years, after which time the appropriate information would hopefully be available

Collaborative Programs

- Community education programs on turtle conservation need to be undertaken
- The Newfoundland sighting program should be continued. Similar programs in other areas should also be supported.
- Assistance should be provided to fishermen to help them to conserve turtles
- Cooperative research efforts with fishermen on turtles should be developed
- Canada's involvement in the Inter-American Convention for the Protection & Conservation of Sea Turtles would be valuable and should be explored.
- Canada should work with southern authorities (Caribbean) to mitigate limiting factors of the turtle populations